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(54) DUST COLLECTION METHOD BY CONTACT ADSORPTIONAND DUST COLLECTOR USING THE METHOD

(57)Abstract:
PURPOSE: To simplify constitutionto control the increase of the pressure loss of fluidand to perform efficient dust collection.
CONSTITUTION: A contact adsorption material 4 set in a frame body 2 is arranged in a passage through which fluid to be treated passes. The material 4 is constituted as a wetting phenomenon type contact adsorption material by making a base material impregnated with an adsorbentor as an electret type contact adsorption material by making plus and minus charges coexist semi-permanently in the base material. Dust in fluid passing through the contact adsorbent 4 is adsorbed and held by the contact adsorption means of the contact adsorbent 4 so that efficient dust collection is performed while the increase in pressure loss being controlled.

CLAIMS

[Claim(s)]
[Claim 1]Contact adsorption material is arranged in a channel of a fluid containing a candidate for catchingcontact adsorption material gets wetand an adsorption means by a phenomenon or electret is establishedA dust collecting method by contact adsorption constituting a candidate for catching in a fluid which passes the contact adsorption material concerned so that adsorption maintenance may be carried out by adsorption means of the contact adsorption material concerned at contact adsorption

material.
[Claim 2]A dust collection device using a contact adsorption dust collecting method characterized by what was constituted by a channel through which a fluid passesa fluidization means of a fan for a fluid to pass through a channel etc.and contact adsorption material arranged all over a channel.
[Claim 3]A dust collection device using the contact adsorption dust collecting method according to claim 2wherein said contact adsorption material gets wet by adhering or impregnating adsorbent to a substrate and is constituted as phenomenon type contact adsorption material.
[Claim 4]A dust collection device using the contact adsorption dust collecting method according to claim 2wherein said contact adsorption material is constituted as electret type contact adsorption material by being constituted so that electrification of plus and electrification of minus may polarize semipermanently and may live together to a substrate.
[Claim 5]A dust collection device using the contact adsorption dust collecting method according to any one of claims 2 to 4wherein a dust collection member is formed by arranging a support member with an aperture size in which pressure loss of a fluid does not go up to a frameand arranging said contact adsorption material so that the support member concerned may be covered.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the dust collection device which enforces a dust collecting method and the methodand presses down the rise of especially temporal pressure lossand its operating cost is cheapand ** is also related with the device which enforces a broad available dust collecting method and the method regardless of industrial use and home use.
[0002]
[Description of the Prior Art]There is the inertial-dust-collection method of using inertia as one of the methods which catches candidates for catching (the candidate for these catching is represented with "dust" below)such as dust of the various kinds generally contained in fluidssuch as airdustor particlesBlinding of a device does not arise butfor a **** reasonthis method has the big feature in the point in which continuous running is possible over a long period of time. Howeverfundamentallythis method has a limit in removal abilityin order that dust removal may be dependent on the mass of dustand removal of detailed dust is difficult andmoreoverneeds to raise the rate of flow of a fluid in the operation of a device. For this reasonit is used mainly as a device for places of businesssuch as a factoryfrom the operating cost of a

devicegenerating of noiseetc.and is a device unsuitable for using it in a homean administration buildingetc.
[0003]
[Problem(s) to be Solved by the Invention]Catching of dust with a filter dust collection and electrostatic precipitation detailed to the above-mentioned inertial-dust-collection method is possibleSince a device can also be miniaturized and it is not necessary to also raise the rate of flow of a fluidthere is also little generating of noisenot only industrial use but a home and an administration building can use itand the device by these methods is used [various] as home use.
[0004]Among thesesince a filter dust collection method is the method of collecting by passing the filtration body of an aperture size smaller than the size of the dust which is a candidate for catching about a fluida filtration body will produce blinding temporally with the caught dust. The pressure loss of the fluid at the time of as a result passing a filtration body goes upand a filtration efficiency will fall due to the fall of processing air capacityand it will require big load for a fan. Dust collection efficiency fallingbecoming a relation with opposite blinding and dust collection efficiency in a filter dust collection methodand preventing blindingif the aperture size of a filtration body is enlarged so that blinding may not be produced with a natural thing but it may ****a device is contradictory constitutionally and it is impossible to raise dust collection efficiency. Thereforein order to maintain the performance of a device and to keep load with a fan impossible for etc. from being appliedperiodical cleaning of a filtration body is indispensable.
[0005]On the other hand also in an electrostatic precipitation methodthe pressure loss of the fluid which dust adheres to an electrode temporally and passes an electrode section goes up. Howeverin this methodalthough it is possible to delay the rise of ********** to devise the structure of an electrodethe dust which adhered beyond the limit needs too periodical cleaningalthough there is a possibility of carrying out a re entrainment and it is not so frequent as a filter type device.
[0006]
[Means for Solving the Problem]This invention is constituted in view of an above-mentioned problemand can remove dust efficientlyand. It is a device which enforces a dust collecting method and the method of reducing a rise of pressure loss of a temporal fluid substantiallyA contact adsorption dust collecting method with which a means to adsorb this and to hold it if contact adsorption material is arranged to a channel of a fluid and dust in a fluid contacts the contact adsorption material is givenAnd it is a device for enforcing the methodand is characterized by a device being a dust collection device using a contact adsorption dust collecting methodwherein flow meanssuch as contact adsorption material arranged in a channel and the channel of a fluid and a fan which gives flow energy to a fluidare arranged.
[0007]
[Function]A means to hold electrically the dust in which it got wet to the substrate to

contact adsorption materialand the dust by a phenomenon adsorbed or contacted is formedandas for the dust in the fluid which sews these contact adsorption material and is passedall almost carry out contact adhesion between them at contact adsorption material. the adhering dust — said — getting wet — a phenomenon — or it is held electrically at the contact adsorption materialand a re entrainment does not carry out. Thusalthough the dust in a fluid is removedsince these contact adsorption material is arranged so that passage of a fluid may be permitted regardless of adsorption of dustthe rise of the pressure loss of the fluid which does not produce what is called blindingtherefore passes the contact adsorption material concerned also becomes small substantially as compared with the conventional method.

[0008]

[Example]A drawing is concretely explained to reference for the example of this invention below.

[0009]Drawing 1 thru/or drawing 3 show the 1st example of this invention. The member shown in drawing 1 is the test equipment for enforcing the method of this inventionand is a member for dust collection in the important section of the device which enforces the method of this invention. The arrow 1 shows a dust collection memberthe numerals 2 are the frames of the dust collection member 1and the frame 2 whole is formed in panel shape by arranging the support member 3 at the fluid channel 2a in which section forming was carried out by the frame 2. It is for the filtration body of a filter type dust separator being differentand this support member 3 supporting the contact adsorption material mentioned later to a prescribed positionFor exampleit has extremely coarse composition of eyessuch as a thing which stretched two or more metal wires in the shape of a lattice or a thing which has arranged the sheet metal of two or more sheets in paralleland also a thing which also constituted ** like the framework of a shoji so that these sheet metal might be intersected perpendicularly. Thereforeeven if dust adheres to the support member 3 which comprises these metal wires and sheet metaltherebythe rise of the pressure loss of a fluid has composition which is not produced.

[0010]Nextthe numerals 4 show contact adsorption material. The contact adsorption material 4 forms the adsorption-and-fixation means of dust to a substrate so that it may mention laterand its shape where specific surface area becomes large is desirable [the shape] in order to set up a touch area with dust greatlyalthough the shape of a substrate can consider various kinds of things. He is trying to cover the whole fluid channel 2a by which a majority of contact adsorption material formed for examplein the shape of twisted yarn is arranged in the shape of a blind in three steps as an upper edge edge is fixed all over the fluid stream ON side of said support member 3and the support member 3 is arranged with the composition of a graphic display.

[0011]Drawing 3 shows the example of the shape of the contact adsorption material 4. The composition of (A) shows first the contact adsorption material which is twisting

the detailed textiles 5 and comprises a funiculose substrate. In this casefrom a funiculose base material surfaceit is desirable to carry out as [**** / to the a large number exterior / detailed textiles]and to make it the specific surface area of the whole substrate increase. Nextthe composition of (B) shows the contact adsorption material in which the substrate was formed in the shape of silk crapeand (C) shows the contact adsorption material from which the thread material which curled is a substrate.

[0012]Nextdrawing 4 and drawing 5 show notionally the contact adsorption of the dust by the above-mentioned contact adsorption material 4and the method with which drawing 5 adsorbs electrically the method which drawing 4 gets wet and uses a phenomenon again is shown respectively. Drawing 4 gets wet first and the method using a phenomenon is explained. If the case where the numerals 6 are substrates and it is the composition that the contact adsorption material 4 was formed in funiculose [of drawing 3 / of (A)] is taken for an exampleeach textiles 5 which are ****(ing) outside from this main part outside the main part formed in funiculose will also function as a substrate respectively. The layer of the adsorbent 7 is formed in the surface of this substrate 6. As a substrateit is usable first in various kinds of materialssuch as metal materialssuch as a paper material of a natural fiber and a natural fibera paper material of a chemical fiber and a chemical fiberand a metallic foiland ceramics.

[0013]As adsorbentthere are a mineral oil agentdrainage system adsorbent (SOA)siliconetc.and these adsorbent 7 is applied or impregnated to the substrate 6. The contact adsorption material which was constituted in this way and which got wet and used the phenomenon is arranged in a fluid. Like drawing 4 (A)the dust 8a in a fluid adheres to the adsorbent 7 by flow of a fluid. As shown in (B)the adhering dust 8a is wrapped in by the adsorbent 7and is held. For this reasoneven if the metaphor dust 8a is the portion wrapped in and heldthe dust 8b which adhered as shown in (C)and adhered to the next is also eventually wrapped in by the adsorbent 7as shown in (D)and the following dust 8b is held. Thusadsorption maintenance of the new dust is carried out one after another until the adsorbent 7 currently stored by the substrate 6 according to being impregnated etc. is lost.

[0014]The contact adsorption material 4 of the above composition is arranged in superposition to the passage of a fluidand if it constitutes so that the fluid itself may sew this contact adsorption material 4 and it may passthe opportunity of contact of the dust 8 to the adsorbent 7 will approach to 100% infinite. For this reasonthe dust 8 in a fluid is caught very efficiently. since the caught dust is firmly held by said adsorbent 7 — the possibility of a re entrainment — completely — there is nothingso that it may say. Since its dust collection efficiency will improve like the examination results mentioned later if the dust collection by this method is different from a filter type and the opportunity of contact of the contact adsorption material 4 and dust is increasedThe rise of the pressure loss of the fluid at the time of contact adsorption

material passage becomes possible [considering it as a low substantially conventionally as compared with a device] by devising the arrangement state of the contact adsorption material 4. Thereforealso when the contact adsorption of the dust according to the adsorbent 7 by not exchanging contact adsorption material for a long period of time etc. should have been saturatedMost passage of a fluid is not checkedtherefore although dust collection efficiency naturally falls greatlydangersuch as load increase of the fan by the rise of the pressure loss of a fluid or overheating of a fandoes not produce it.

[0015]Nextdrawing 5 shows the dust collection method by electric force. Although the dust collection method by electric force has a method by frictional electrificationand a method by EREKKUTO letit is a method by electret which is used for this invention.

[0016]Since the substrate is first charged in plus or minus by the frictional electrification methodit is possible to draw dust and to make it adhere from a distancebut. Since it is shortly ****ed to a substrate since the dust which the dust drawn once fell easily since it was easy to move an electric chargeand fell once is charged on the same pole as a substrateand it stops adheringit is disqualified as contact adsorption material of this invention.

[0017]Since the electret method is constituted on the other hand so that the substrate 6 may polarize electrification of plusand electrification of minus semipermanently and it may live together as shown in drawing 5Although the dust 8 cannot be drawn near from a distanceit is a raw material suitable as contact adsorption material using the electric force which can hold certainly the dust which carried out contact adsorption to electrification of the dust 8 in contact with a substrate being plus once regardless of ** by minusand carries out this invention.

[0018]Drawing 6 thru/or drawing 8 show the result of the performance comparative study of the contact adsorption dust collection device which enforces the method concerning this inventionand other dust collection devices. The device first applied to this invention among test equipments is constituted so that a gas may pass this contact adsorption material with the fan which is a dust collection member of composition of having arranged the contact adsorption material 4 so that the support member 3 may be covered to the frame 2 which has the support member 3 as shown in drawing 1and is not illustrated. as for this invention devicetwo kinds of contact adsorption material are usedand one of them comprises what was impregnated with straight mineral oil as adsorbent to the substrate of composition of being shown in (a) drawing 3 (A) — it gets wet and is a contact adsorption dust collection device of phenomenon use.

Other one is the electret contact adsorption material dust collection device which carried out electret treatment to the substrate shown in (b) drawing 3 (B).

[0019]The conventional-type device which did the comparative study is with the home electrostatic precipitator (below/by S company "electrostatic precipitator"

carries out) which has the (c) fanand a home ionic formula dust collection device (below/by T company "funless ion device" carries out) without the (d) fan. (a) – (d) shown in each diagram of drawing 6 thru/or drawing 8 shows the test result of the device of each above-mentioned device (a) – (d)respectively.

[0020]Drawing 6 is the result of comparing the dust collecting performance to dust with a sizes [most] of not less than 5 micrometers in a homean administration buildingetc. first. The examination was done by arranging each device to the space which has the number of dust of the specified quantityand measuring the decrement of the number of dust after specified time elapse. The vertical axis in a figure shows the number of dust (piece/ft^3)and a horizontal axis shows progress of time.

[0021]This invention got wet firstand phenomenon type contact adsorption material (a) collected dust to such an extent that measurement of dust became impossible in about 20 minutes. moreover -- although ** electret type contact adsorption material (b) and an electrostatic precipitator (c) were damp and the number of dust decreased earlier than a phenomenon type contact adsorption dust collection device (a)nearly perfect removal of dust is in about 20 minutes -- said -- it got wet and was almost the same as the phenomenon type contact adsorption dust collection device (a). On the other handdust collecting performance was considerably inferior in the funless ion device (d)and about 50 dust remained even after 30-minute progress.

[0022]Drawing 7 shows the result of a removal examination of 1.0-5.0-micrometer dust. Although the dust collection of an electrostatic precipitator (c) is the best in the case of the dust of this size and the electret type contact adsorption dust collection device (b) of the invention in this application followed thisabout 20 minutes after ******dust was almost lostand there was almost no difference at the removing time of dust. On the other handit got wetand as for the phenomenon type contact adsorption dust collection device (a)mist and the performance fell from above-mentioned bothand the number of dust of about 3000 pieces was checked even for after about 30-minute progress. To these devicesthe funless ion device (d) was considerably inferiorand measured the number of dust of about 7000 pieces also after 30-minute progress.

[0023]Drawing 8 shows in a home the result of a removal examination of the 0.3-1.0-micrometer dust which hardly poses a problem. In the case of the dust of this classthe electrostatic precipitator (c) was effective tooandthe 500 or less dust number and 30 minutes afterwardit decreased to about 300 15 minutes afterward. On the other handalthough the electret type contact adsorption dust collection device (b) was less than said electrostatic precipitatorit turned out that the almost same dust reduction process as an electrostatic precipitator is followedand it decreases to about about 1400 in 30 minutesand is equal to use enough. With an electret type devicethis is small if it compares with a static electricity methodbut it is considered that it is because the suction capacity of dust exists to some extent. On the other handit got wet and it turned out in the phenomenon type contact adsorption dust

collection device (a) that about 17000 dust remains and dust collecting capacity falls greatly also after 30-minute progress as compared with the two above-mentioned person. This gets wetand since there is no capability to attract dust in phenomenon type contact adsorption materialit is considered for the considerable amount of such detailed dust to have passed between contact adsorption material. moreover — a funless ion device (d) has a low effect — after 30-minute progress — the number of dust — about 20000 **** — it was hardly decreasing.

[0024]It became clear from the above test result be [of 1.0 micrometers or more] dust and that especially the removal efficiency of 5.0-micrometer dust was very highand it turned out in this range that it has the dust collecting capacity which is equal to the electrostatic precipitator which demand is increasing from the former according to high dust collecting capacity. Since it does not have an electrode etc. which high tension requires as compared with an electrostatic precipitatorthe composition of a device does not have time and effortsuch as washing of an electrode which had to be performed by paying careful attention very simplyeither.

[0025]NextTable 1 shown below shows the pressure loss accompanying the dust collection volume of each raw material and the catching to the amount of dust added in a fluidand is **. The unit of g and pressure loss (pressure loss) of the unit of the collection volume in front is mmH_2O.

[0026]

[Table 1]

[0027]collection efficiency [in / on the above-mentioned table and / each dust amount of supply] — any of two persons of this application — although — it is higher than a nonwoven fabric. Specifically get wet and the collection efficiency of phenomenon type contact adsorption material in the dust amount of supply of 5 g 92%In 85% and the 15git is about 87% at the 10g o'clockand electret type contact adsorption material is [dust amount-of-supply the o'clock of 5g] about 83% 85% in the 10g o'clock 90% at 15g o'clock. On the other handa nonwoven fabric is 79% in the 72% and 10g o'clock at 80% and 15g o'clockandas for the contact adsorption material which starts the invention in this application firstit turns out that the dust collection efficiency itself is superior to a nonwoven fabric at dust amount-of-supply the o'clock of 5g.

[0028]Nextwhen the rise of pressure loss is consideredit gets wetphenomenon type contact adsorption material is set to 1.1 to 5.4 (unit is the same as that of mmH_2O / following) from dust amount-of-supply the o'clock of 0g in 15g o'clockand it is about 5 times the increasing rate of this. Electret type contact adsorption material is set to 1.2 to 6.9 from dust amount-of-supply the o'clock of 0g in 15g o'clockand is about 6 times as many rises. On the other handa nonwoven fabric will be set to 0.8 to 8.6 from dust amount-of-supply the o'clock of 0g in 15g o'clockand will go up by about 11

times. That isalthough dust collecting capacity was inferior in the dust collection device of a filtration method from this point as compared with the invention in this applicationit turned out that pressure loss goes up to the about twice of the invention in this application. That isit is shown that the invention in this application can hold high dust collection efficiency over a long period of timemaintaining low pressure loss.
[0029]Since this application device in the above examination is arranged so that the contact adsorption material 4 may cover the support member 3 to the fluid passage shown by an arrow as shown in drawing 1it has composition which these contact adsorption material 4 comes to stick to the support member 3 by a fluid passage. On the other handif leave the supporter of the contact adsorption material 4 of each stageand the support member 3 is removedor ** also arranges these contact adsorption material 4 like a streamer to a fluid as a fluid is passed behind behind the support member 3 contrary to drawing 1Although dust collection efficiency falls a littleit is expected that pressure loss will decline still more nearly substantially.
[0030]Drawing 9 graph-izes change of the pressure loss in the dust amount of supply in the above-mentioned tablein the inside A of a figurethe invention in this application gets wetand B of phenomenon type contact adsorption material is the electret type contact adsorption materialand C shows change of the pressure loss of a nonwoven fabric respectively.
[0031]Since this invention has the above featuresit can consider various kinds of usessuch as an industrial several kinds filter for air conditioninga filter for clean roomsand a filter for inhalation-of-air pure [engine]outside a use for home use.
[0032]
[Effect of the Invention]As this invention was explained concretely aboveit is possible to remove the dust in a fluid effectivelyAnd only by contact adsorption material being arranged in the space through which a fluid passes fundamentallysince dust can be collectedcan simplify the composition of the whole deviceand it is cheapand the special maintenance service is unnecessary in addition to exchange of contact adsorption material.
[0033]Even if dust is caught and catching dust is saturated depending on the casethere are few rises of the pressure loss of a passage fluidtherefore it is possible to operate the device by this method safely and economically over a long time.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a perspective view of a dust collection member which accomplishes the important section of the device concerning the method of this invention.
[Drawing 2]It is a sectional view by the A-A line of the dust collection member shown in drawing 1.

[Drawing 3](A) Or it is a figure in which all of (C) show the composition of the substrate of contact adsorption material.
[Drawing 4]It is a key map in which getting wet and showing the dust adsorbed state of phenomenon type contact adsorption material.
[Drawing 5]It is a key map showing the dust adsorbed state of electret type contact adsorption material.
[Drawing 6]It is a diagram showing the result in which the dust collecting performance of the contact adsorption device and conventional–type device concerning the invention in this application in the not less than 5.0–micrometer dust for catching did the comparative study.
[Drawing 7]It is a diagram showing the result in which the dust collecting performance of the contact adsorption device and conventional–type device concerning the invention in this application in the not less than 1.0–5.0–micrometer dust for catching did the comparative study.
[Drawing 8]It is a diagram showing the result in which the dust collecting performance of the contact adsorption device and conventional–type device concerning the invention in this application in the dust for catching of 0.3–1.0 micrometers or more did the comparative study.
[Drawing 9]It is a diagram showing the result of having measured change of the pressure loss of the contact adsorption material and nonwoven fabric concerning the invention in this application in each dust amount of supplyrespectively.
[Description of Notations]
1 Dust collection member
2 Frame
3 Support member
4 Contact adsorption material
88aand 8b Dust